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THE USE AND EXPENSE OF FARM IMPLEMENTS

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CONTENTS

		Page
PART 1.	FARM IMPLEMENT EXPENSE AND USE	
	Life of farm implements	237
	Annual expense of using farm implements	238
	Distribution of total annual expense. Depreciation and repair expense	238
	Use and unit expense of farm implements	241
	Operating expense of the tractor	241
PART 2.	FACTORS THAT AFFECT THE EXPENSE OF USING FARM IMPLEMENTS	
	Influence of crop acres upon expense	242
	Relation of use to expense	243
	Tractor	244
	Grain Binder	244
	Influence of type of labor upon annual expense	245
	Expense on farms with and without repair shops	246
	Housing practices that affect expense	246
	Purchasing and discarding practices that influence expense	247
SUMMARY		250
APPENDIX		252

BULLETIN NO. 345

The Use and Expense of Farm Implements

By GEO. B. BYERS and B. T. INMAN

This bulletin presents a description of the use and an analysis of the expense of farm implements on 101 farms in southern Christian and Todd Counties, for the farm year, 1930. These counties are representative of those sections of Kentucky in which machinery is used most extensively. The area included is comparatively level. The soil is a fertile, well drained and well aerated loam.

PART 1. FARM IMPLEMENT EXPENSE AND USE

Over ninety different kinds of farm implements were reported on the 101 farms. Twenty of these kinds were on only one farm each. The wagon was the only implement on all farms, whereas eighteen kinds of implements were on each of seventy-five farms. Some small implements such as the one-horse corn planter and tobacco hiller were found only on the small farms. Farms with over 350 crop acres had practically the same variety of implements as farms with 225 crop acres. Machines having a relatively high first cost and for which much less expensive implements may be substituted were rarely found on small farms.

Life of Implements. The largest factor of implement expense was depreciation, which is largely dependent upon years of life. The average life varied from 6 years[1] for the lespedeza seed pan to 32.5 years for the steam tractor. In considering the life of farm implements the days of annual use should be taken into account. The average life of the mower represented a total

[1] Appendix, Table 1.

of 120.6 days of service.[2] In contrast the wagon averaged 1,099 days of total service. The use of the tractor averaged 27.7 days a year, or a total service of 294 days. As a rule the more complex machines with moving parts had relatively short lives.

Annual Expense of Using Implements. An analysis of the farm expenditures for the 101 farms showed $169 implement expense per farm per year, or 8.4 percent of the total current farm expenses, distributed as follows: Repairs, 2.6 percent; fuel and oil, 2 percent; and hired implements, 3.8 percent. The average total annual expense of implements on the 101 farms varied from $180 for the steam tractor to less than one dollar for many of the smaller implements such as sleds, breaking plows, smoothing drags and small cultivators.

Distribution of Total Annual Expense. Depreciation and Repair Expense. For the implements studied depreciation was 47.7 percent of the total annual expense;[3] repairs, 22.4 percent; interest, 17.8 percent; housing, 4.6 percent; oil and grease, 4.6

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[2] Appendix, Tables 1, 2, and 3.

[3] The principal items of annual expense of farm implements are depreciation, repairs, interest, insurance, taxes, housing, and oil and grease. Repairs, oil, grease and taxes are cash expenditures while depreciation and interest are annual charges computed from the original purchase price of the implement. The repair charge was the normal expense incurred for the past several years. The housing charge may be for a building erected especially for the implements or for the use of a portion of a building that has been built for some other purpose. In the latter case the farmer is enabled to distribute his overhead expense and thereby reduce the housing charge.

Depreciation, interest, insurance and taxes were calculated from the original cost in order to give a uniform annual expense thruout the life of the implement. Annual depreciation was obtained by dividing the original cost by the estimated years of service. Interest charges were five percent of one-half of the original cost. This gave the same interest and depreciation charge annually during the life of the machine. The insurance charge was based on a rate of $2.60 per $100 for a three-year period. It was applied to one-third of the purchase price of the implement. This assumes farm implements to be insured for two-thirds of their average value For taxes, one-half of the average annual value for the life of the implement was multiplied by the state tax rate of 50 cents per $100 value. One-half of the average annual value is assumed to equal the assessed valuation.

Most of the implements in this study were housed in tobacco barns, which necessitated the allocating of a portion of the annual building charge to implements. The total annual charge for the building was calculated by taking 10 percent of the replacement value of the building. This 10 percent covers depreciation, taxes, interest and up-keep on buildings. Thirty percent of this annual charge was allocated to the floor space. The fractional part of the floor space occupied by implements gave the factor used to determine the portion of the floor space charge to be assigned to implements. This housing charge per farm was further distributed to individual implements according to the present value of each implement.

The quantity and value of oil used in motors was ascertained in each case. All other oil and grease used during the year was obtained in terms of total quantity and value. These values were distributed on the basis of annual days of use for those machines using oil and grease.

percent; insurance, 2 percent, and taxes .9 percent. Original cost, years of service and days of annual use are the most important factors affecting the annual expense. The average total annual expense of operating all farm implements on the 101 farms was 14.1 percent of the original cost (or purchase price). Of this 14.1 percent, depreciation constituted 6.7 percent; repairs, 3.1 percent; and other expenses, 4.3 percent. (Table 1.)

TABLE 1. Percentage Distribution of Total Annual Expense of Implements, Based on Original Cost[1]

Kind of implement	Number of implements	Original cost for implement	Percent of original cost			
			Total annual expense	Annual depreciation	Annual repair expense	Other annual expense
Wagon	220	$85.35	13.9	5.6	3.3	5.0
Hay frame	180	17.03	16.3	9.5	3.3	3.5
Wagon box	104	19.94	14.0	8.5	1.8	3.7
Buggy	40	117.11	18.8	9.1	5.8	3.9
Sled	23	3.46	22.5	18.5	.6	3.4
Gasoline engine	20	125.25	16.7	5.7	3.5	7.5
Steam tractor	6	2,566.67	7.0	3.2	.7	3.1
Tractor	44.5[2]	830.56	17.8	10.4	1.9	5.5
Tractor implements:						
Plow	27.5	128.55	11.6	6.1	1.9	3.6
Disk	40.5	122.28	12.0	6.6	1.7	3.7
Cultivator	8.5	141.94	12.6	7.6	1.0	4.0
Mower	7.5	103.93	23.1	10.4	8.8	3.9
Breaking plows:						
2-Horse	178	16.03	18.0	4.7	9.5	3.8
3-Horse	151	19.74	21.6	4.8	13.0	3.8
1-Horse	189	7.04	11.8	4.4	3.4	4.0
Sulky	33	52.64	14.3	5.1	5.5	3.7
Disk harrow	132	47.69	13.0	5.3	3.6	4.1
Spike harrow	150	17.70	15.2	6.4	5.0	3.8
Smoothing drag	61	4.56	17.2	13.4	.4	3.4
Roller	28.2	35.00	8.7	4.1	.8	3.8
Cultipacker	30	62.27	8.9	4.3	.8	3.8
Rotary hoe	12.5	76.32	14.8	8.8	1.9	4.1
Cultivators:						
Two-horse riding	176	56.45	19.0	6.4	2.9	9.7
Five shovel	32	6.05	12.6	5.8	2.8	4.0
Double shovel	225	5.26	15.2	5.5	5.9	3.8
Rastus	270	7.45	17.0	5.6	7.5	3.9
1-horse harrow	310	5.38	14.9	5.8	5.2	3.9
Single shovel	21	3.77	9.8	5.3	.8	3.7
1-horse block	11	1.64	22.6	18.9	———	3.7
1-horse corn planter	13	17.31	10.8	6.2	.6	4.0
2-horse corn planter	95.5	61.09	11.1	5.6	1.5	4.0
Grain drill	82.5	77.78	10.3	4.9	1.9	3.5
Team grass seeder	6	57.50	8.5	3.7	1.6	3.2
Hand grass seeder	251	1.16	23.3	17.2	2.6	3.5
Plant setter	14	87.00	10.7	4.8	2.0	3.9
Hand plant setter	8	4.81	13.3	10.2	———	3.1
Mower	130	66.93	19.3	6.7	8.7	3.9
Rakes:						
Bull	15	41.73	15.9	7.6	4.3	4.0
Sulky	93.5	29.07	10.3	4.6	1.8	3.9

TABLE 1. Percentage Distribution of Total Annual Expense of Implements, Based on Original Cost—Continued

Kind of implement	Number of implements	Original cost for implement	Percent of original cost			
			Total annual expense	Annual depreciation	Annual repair expense	Other annual expense
Hay tedder	14	$54.82	9.8	4.9	1.4	3.5
Hay press	10.5	564.29	10.2	4.7	1.9	3.6
Hay fork	78	8.25	21.2	3.9	12.2	5.1
Seed pan	27	10.89	23.8	19.4	.2	4.2
Grain binder	56	159.68	12.0	5.1	3.3	3.6
Tobacco hiller	9	14.56	6.1	3.4	.3	2.4
Corn sheller	29	12.10	8.3	4.0	.2	4.1
Ensilage cutter	8.7	287.93	11.7	5.2	3.0	3.5
Wagon harness	237	36.29	13.0	5.4	3.9	3.7
Other harness (single)	669	6.80	21.8	6.5	11.2	4.1
Cream separator	36	87.03	14.3	7.9	1.8	4.6
Cold water cream separator	25	4.19	17.2	13.1	.2	3.9
Milk cans (farms	66)	12.09	15.6	11.7	.2	3.7
Self-feeder	29	14.79	11.3	7.4	.9	3.0
Incubator	12	26.83	10.0	5.9	.7	3.4
Brooder	10	17.70	19.0	8.0	7.5	3.5
Manure spreader	38.2	126.74	11.1	6.3	1.0	3.8
Lime spreader	18	59.73	11.5	6.3	1.5	3.7
End-gate lime spreader	10	48.73	13.1	6.9	1.8	4.4
Feed grinder	12.5	87.84	11.4	6.6	1.0	3.8
Fanning mill	11.5	33.30	8.3	4.5	———	3.8
Sprayers:						
Tobacco	9	8.94	17.2	11.5	2.5	3.2
Grindstone	67	4.04	9.9	5.4	.2	4.3
Emery	21	8.64	14.4	8.9	1.1	4.4
Fence tools (farms	77)	9.25	9.3	4.1	1.2	4.0
Average	———	———	14.1	6.7	3.1	4.3

[1] This table presents data only for those implements which were reported by 6 or more operators. Similar data for implements reported by five or fewer operators are presented in the appendix. (Table 4.)

[2] Indicates some are partnership implements.

The total annual expense of individual implements ranged from 6.1 percent of the original cost for the tobacco hiller to 31.1 percent for the electric motor. Depreciation ranged from 3.2 percent of the original cost for the steam tractor to 20.8 percent, for the electric motor. Annual repairs ranged from nothing for some of the simplest implements to 13 percent for the three-horse breaking plow. The percentage that the annual expense was of the original cost gives the operator a means of approximating his probable annual expense and thereby affords him a guide in deciding whether or not to purchase a given machine.

Use and Unit Expense of Farm Implements. The use of farm implements may be measured in terms of hours used or acres covered. Gasoline engines, wagons, tractors, threshers and hullers are implements whose use and expense[4] can best be measured in hours of work. Acres covered and hours worked are good measures of use and expense[5] for the implements employed in fertilizing land, tilling land and spraying, seeding and harvesting crops.

Annual use ranged from about three days for the one-horse corn planter and the sulky rake to over three hundred days for the cold water separator.[6] Land covered annually ranged from about 7½ acres for the single-shovel plow to 295 acres for the two-row horse-drawn cultivator. The fixed or overhead charges such as housing, taxes and interest are affected very little by amount of annual use. Depreciation is not proportional to annual use. Thus it follows that increased annual use reduces the expense per acre or per day of service.

Operating Expense of the Tractor.[7] Of the tractor operations drawbar work accounted for 65.2 percent of use while belt work made up 34.8 percent. The tractors included in this study were used 28.8 days per tractor annually. The tractors used for drawbar work gave an average of 19.2 days of drawbar service. Disking made up approximately half of the drawbar work while plowing accounted for about 25 percent. Feed grinding and hay baling accounted for about two-thirds of the belt work done by 24 tractors. The cost of drawbar work averaged 81 cents per hour and ranged from 72 cents an hour for tractor mowing to 86 cents per hour for combining. The cost of belt work averaged seventy-two cents per hour ranging from sixty cents for shelling corn to seventy-five cents for filling silo.

The expense of tractor operation per acre covered varied widely for different kinds of drawbar work. The total tractor expense including fuel ranged from 24 cents an acre for pulling the rotary hoe to $1.12 an acre for breaking ground. (Table 2.)

[4] Appendix, Table 2.
[5] Appendix, Table 3.
[6] Appendix, Tables 2 and 3.
[7] Appendix, Table 5.

TABLE 2. Acres Covered, Fuel Consumed and Total Expense[1] of Drawbar Work for 45 Tractors[2] on Christian and Todd County Farms, 1930

Kind of work	Number of tractors	Acres covered per tractor		Fuel[5] consumed per acre (gals.)	Total tractor expense (an acre)
		Annually	Per ten hr. day		
Disking	42	175	18.2	1.05	$0.45
Plowing	24	46	6.5	3.15	1.12
Harrowing	10	120	26.4	.67	.28
Cultivating corn	8[3]	186	20.1	.81	.32
Mowing	7[3]	176	18.9	.81	.25
Drawing binder	5	58	21.3	.77	.25
Dragging	4[4]	64	16.4	1.17	.73
Raking (bull rake)	2[3]	83	10.3	1.41	.67
Disk tiller plowing	1[3]	79	10.0	1.67	.49
Rotary hoe cultivating	1	135	25.0	.67	.24
Combining	1	93	14.8	1.42	.43

[1] Does not include labor cost in operating tractor or cost of implement drawn.
[2] Thirty-six tractors were rated as two-plow tractors, the other 9 as 3-plow.
[3] All 10-20 horse power tractors.
[4] Three did less than 100 hours total work per tractor annually.
[5] Two tractors used gasoline for fuel.

A large proportion of farmers expressed the opinion that tractor breaking is too expensive and for this reason they were not using the tractor breaking plow as they had planned to use it when purchased.

The average rate of work per ten-hour day with tractor tillage and harvesting implements was 2.6 acres per foot of working width and approximately 1.9 acres per foot of working width for horse drawn implements. The rates for individual implements varied considerably depending upon the size of the tractor or teams and the amount of drawbar load.

PART 2. FACTORS THAT AFFECT THE EXPENSE OF USING FARM IMPLEMENTS

The expense of farm implements was influenced by a number of factors the more important of which were size of farm as measured by crop acres on which the implements were used; days of annual use; type of labor used in operating the implement; use of repair shop; housing practices; and purchasing and discarding practices.

Influence of Crop Acres Upon Expense. That the size of farm affects the economical use of implements is shown in the

data of this study by comparing the implement investment and expense for farms of various sizes in terms of acres of crops on which the implements were used. This relationship is shown in Table 3.

TABLE 3. Relation of Crop Acres to Implement Investment and Expense

Crop acres per farm	Number of farms	Per farm		Per crop acre	
		Crop acres	Implement investment	Implement investment	Annual implement expense
1 to 50	11	36	$254	$7.11	$2.60
51 to 100	35	74	402	5.43	2.07
101 to 150	23	128	866[1]	6.76[1]	2.31[1]
151 to 200	12	171	1,127	6.61	2.10
201 to 250	11	216	1,526[1]	7.06	2.91[1]
Over 250	9	414	2,012	4.86	1.86

[1] These figures are influenced to some extent by larger implement investment per farm because more farms of these sizes do custom work than other sized farms.

The small farms with fifty crop acres or less used about as many implements per farm as the farms with an average of 74 crop acres per farm.[8] This resulted in a larger expense per crop acre in the group of smaller farms. When crops exceed the acreage which can be handled by a single implement and that implement is duplicated, the acreage of the crop upon which this class of implement is used must be increased materially if the full use is to be gotten from both implements. This doubtless explains why the implement expense on the farms averaging 128 crop acres and 216 crop acres was higher than on farms having smaller acreages. The fact that these two high-cost groups did considerble custom work further emphasizes the maladjustment of implements to crop acres. The group of farms with 250 or more crop acres had the minimum implement investment and minimum annual expense per crop acre.

Relation of Use to Expense. The unit expense of farm implements tended to decrease as annual use increased. The tractor, binder and mower which represent the more commonly used expensive machines serve to illustrate the effect of the number of days of annual use upon implement expense.

[8] Appendix, Table 6.

Tractor. The expense per hour of tractor operation decreased rapidly until 400 hours of work were done annually. (Table 4.) Since the variation in fuel and oil expense was com-

TABLE 4. Relation of Hours of Work Per Tractor Annually to Expense Per Hour of Operation, for 45 Tractors

Hours work per tractor	Number tractors	Average hours work	Fuel and oil expense	Total expense
Two-plow tractors[1]				
200 or less	21	106	$0.35	$1.53
201 to 400	6	265	.30	.75
401 to 600	3	485	.27	.54
Over 600	6	802	.29	.49
Three-plow tractors[2]				
200 or less	4	114	.42	1.72
201 to 400	4	295	.36	1.07
401 to 600	—	—	—	—
Over 600	1	948	.29	.57

[1] This division is made on rated horse power. Some tractors were not used for plowing.
[2] Two tractors were used with small, four-disk plows.

paratively small, the reduction in expense an hour was accomplished mainly by spreading the fixed overhead expense over a greater number of hours.

The use of a tractor for a specific job such as disking tends to limit the tractor work done annually. It adds to the expense of operating the farm since farmers do not materially reduce the number of work stock on the farm until a tractor and tractor equipment are purchased for general farm use. A comparison of the number of horses on farms without a tractor and with one tractor showed very little if any reduction in number of horses due to the purchase of a tractor. The farms with a hundred crop acres or less without a tractor used 4.7 head of work stock per farm whereas the same sized farms with one tractor used 4.1 head of work stock per farm. This slight difference was typical of the other size groupings. When the second tractor was added some reduction in work stock resulted.

Grain Binder. There was a seventy-two cent decrease in the per acre expense on grain binders when the average acreage

covered increased from 14 to 76 acres. (Table 5.) The use of nine binders that harvested an average of 14 acres had an expense of $1.03 per acre whereas the use of 7 binders which

TABLE 5. Relation of Acres Harvested Annually Per Binder to Expense,[1] for 56 Binders

Acres harvested per binder annually	Number of binders	Per binder		Per acre		
		Acres harvested	Annual expense	Annual expense	Repair expense	Depreciation
Less than 21	9	14	$14.16	$1.03	$0.33	$0.38
21 to 40	25	29	14.64	.63	.19	.26
41 to 60	15	54	20.23	.37	.08	.18
Over 60	7	76	23.53	.31	.08	.14
All binders	56	39	18.98	.48	.13	.21

[1] Does not include cost of labor of operator or horse work.

harvested an average of 76 acres showed an annual expense of 31 cents per acre. An increase from 54 to 76 acres harvested resulted in a decrease of only 6 cents in expense an acre. The expense for repairs decreased from 33 cents per acre for binders cutting 14 acres to 8 cents for binders cutting 54 acres. The depreciation per acre declined rapidly with an annual use up to 54 acres but less rapidly after that acreage was reached. These data indicate that a farm should have a minimum of fifty acres of annual binder work to justify the purchase of a binder if a machine can be hired when needed. The annual use of binders is often increased and the annual expense per acre decreased by doing custom work.

Influence of Type of Labor Upon Annual Expense. Machinery repair expense increased as hired labor used to operate farm machines increased. (Table 6.) Farms with less than

TABLE 6. Effect of Hired Labor on Implement Repair Expense

Percent of operation by hired labor	Number of farms	Repair expense per $100 implement investment
1 to 33.3	13[1]	$6.12
33.4 to 66.6	25	6.98
66.7 to 100	61	8.37

[1] Two farms omitted—abnormal repair expense.

one-third of the machine operations handled by hired labor showed a $2.25 smaller repair expense for each $100 of machinery investment than those on which two-thirds or more of the machine operations were handled by hired labor. The owner operation of the more complicated machines resulted in an average saving of about $20 per farm.

Expense on Farms With and Without Repair Shop. The repair shop made possible a saving of $5.47 in expense for each $100 of implement investment, by the use of 1¼ hours of additional farm labor. (Table 7.) This saving was due to the

TABLE 7. A Comparison Between Farms With and Without a Repair Shop

	Farms having repair shops	Farms without repair shops
Number of farms	39	62
Farm implement investment per farm	$1,195[1]	$556[1]
Farm implement investment per crop acre	6.67[1]	4.45[1]
Value of shop equipment	37.44[2]	9.06[3]
Value of shop equipment per $100 implement investment	3.13	1.63
Annual expense per $100 implement investment:		
Total annual expense	$36.75	$42.22
Repair expense	7.70	9.86
Depreciation	17.32	19.98
Hours of farm labor used	3.85 hrs.	2.62 hrs.

[1] Does not include investment in shop equipment.
[2] Includes blacksmith and carpenter tools.
[3] Includes carpenter tools only. No blacksmith tools were owned.

avoidance of much high-priced mechanical labor and the use of farm labor during slack periods of the year. This farm labor amounted to about 46 hours per farm with shops and 15 hours per farm without shops or a difference of 31 hours. Having the facilities to repair implements during odd times thru the year tends to keep the implements in better condition, prevents the loss of time during busy seasons and enables the farmer to make more economical use of his farm implements.

Housing Practices that Affect Expense. The most usual place of housing farm implements was the tobacco barn which with few exceptions provided adequate storage space. Wagons

probably showed a larger variation in the amount of time housed than any other implement, ranging from no housing to housing during the entire year except when in actual use. Forty-three of the forty-five tractors were housed twelve months except for occasional days during periods of peak work. Breaking plows, disk harrows, one- and two-horse cultivators, rollers and cultipackers usually were housed during the fall and winter but were not housed so regularly during the cropping season. A large number of sulky hay rakes were not housed. This was because of the small amount of wooden parts in a rake, subject to rotting, and the large space required for housing. It seldom occurred that grain drills, binders and manure spreaders were not housed except for a month or two during the working season.

A majority of the farmers protected the bright parts of implements against rust by oiling after using. Oil drained from the crank case of the tractor or car was used most frequently for that purpose.

Since practices in housing mowers were different, an apportunity was afforded to study the relation of expense to housing. (Table 8.) The repair expense per mower was 60% greater for

TABLE 8. Relation of Housing to Annual Expense, for 130 Mowers

Period housed (months)	Number of mowers	Per mower			Per acre	
		Acres covered	Annual expense	Repair expense	Annual expense	Repair expense
					(cents)	(cents)
Less than 10	29	47.7	$13.90	$7.09	29.1	14.8
10 or more	101	58.9	12.61	5.42	21.4	9.2
All mowers	130	56.4	12.90	5.80	22.8	10.2

those which were housed for less than ten months of the year than for those which were housed ten months or more.

Purchasing and Discarding Practices that Influence Expense. The proper selection of farm implements and their adaptation to the mechanical demands of these farms determined to a considerable extent the service obtained from them. Often implements were discarded before they were worn out because no use could be made of them. Sixty-two implements were dis-

carded because they were not needed tho still in working condition.[9] Several of these, such as tractor plows and grain drills, had a comparatively high original cost. Changes in crops or livestock raised or changes in production methods accounted for many implements not being needed. Some of the implements which were not needed at the time were purchased at public sales because of a low price. Some implements were in disuse because they were out of repair and the need for them was not great enough to justify the expense of repairs.

Forty implements were discarded because they were not adapted to the work. The invention and introduction of new types of implements capable of doing the work more satisfactorily than implements already in use caused the latter to be discarded. For example, the 3-shovel cultivator has largely displaced the double shovel and the one-horse plow for cultivating tobacco.

The implements included in the study were depreciated to an extent considerably more than half of their normal expected life, yet few implements were purchased during the time covered by the study. This failure to purchase at a normal rate may be attributed to the unfavorable relationship between the prices of farm products and the prices paid for farm implements.

The practice of buying the more expensive implements in partnership is often used and seems to work well where farmers are accustomed to cooperating. Implements best adapted to partnership ownership are those that are used but few days annually and are not needed on different farms at a specific time. Such implements most commonly owned in partnership are the hay press, lime spreader, ensilage cutter, feed grinder and cultipacker. This practice of cooperative purchase often permits the farmer to own implements that he would otherwise be unable to buy. Borrowing or exchanging implements was reported an unpopular practice in most instances principally because of the difficulty in handling repair expenses.

As a check on the estimates of the probable remaining life

[9] Appendix, Table 7.

TABLE 9. Life, Use, and Cost Per Implement Worn Out[1]

	Number implements	Original cost	Present value	Average annual repair expense	Total years of service	Average acres covered annually	Average days use annually	Annual depreciation expense
Wagon	4	$57.50	$3.75	$4.13	22.8	———	61.3	$2.36
Wagon box	1	6.00	———	———	4	———	20	1.50
Tractor	2	687.50	17.50	45.00	10	———	20	67.00
Disk harrow	3	46.67	2.33	1.50	20	65	14.7	2.22
Spike harrow	2	16.00	1.00	.05	14	50	5	1.07
Cultipacker	3	45.00	2.67	.57	17	35	1.7	2.49
2-horse riding cultivator	2	32.50	3.50	2.63	21.5	83	8.5	1.30
2-horse corn planter	3	40.00	3.00	.30	16.7	81.3	4.3	2.22
Grain drill	4	62.50	1.50	1.12	19.5	40	4.0	3.13
Mower	4	41.25	5.00	4.00	15.8	33	3.8	2.29
Grain binder	3	125.00	4.67	4.67	12.7	49	4	9.47
Ensilage cutter	1	250.00	5.00	2.00	12	———	2	20.42
Electric motor	1	30.00	———	———	1	———	365	30.00
Sulky rake	2	25.00	.50	.25	16.5	80	5	1.59
Manure spreader	3	118.33	5.00	1.33	13.7	39	14.3	8.27
Lime spreader	1	20.00	———	———	8	25	2	2.50

[1] This includes implements recently worn out and discarded before 1931.

of implements included in this study, records were obtained of the actual period of service obtained from 39 implements which had recently been worn out and discarded. (Table 9.) They show that the days of annual use and the annual expense did not differ greatly from those of implements still in use.

SUMMARY

This report presents a description of the use and analysis of the investment and expense of farm implements on 101 farms in Christian and Todd counties, for the farm year, 1930. This area was selected as representative of the sections of the state in which machinery is being used extensively.

Farm implements represent 3.5 percent of the farm investment for the state and 4.6 percent for the farms studied. The total current implement expense on these farms was 8.4 percent of the current farm expenses for 1929.

Over ninety different kinds of implements were reported on the 101 farms. The wagon was the only implement found on all farms.

The total days of service during the life of most implements was short. This was largely due to the short seasonal use of many implements.

Depreciation represented 47.7 percent of the total annual expense of farm implements on the 101 farms; repairs, 22.4 percent; interest, 17.8 percent; housing, 4.6 percent; oil and grease, 4.6 percent; insurance, 2 percent; and taxes, .9 percent. Since depreciation, the largest single item of expense, was not proportional to annual use, increased annual use reduced the unit expense.

Forty-five tractors showed an average annual use per tractor of 28.8 days of which 65.2 percent was drawbar work and 34.8 percent belt work. The drawbar expense averaged eighty-one cents per hour and belt work, seventy-two cents per hour. The expense of tractor operation per acre covered varied from 24 cents an acre for pulling the rotary hoe to $1.12 an acre for breaking ground.

The expense of farm implements was influenced by size of

farm, days of annual use, type of operating labor, use of repair shop, and housing, purchasing and discarding practices.

Size of farm and annual use are closely related in their effect upon the economical use of implements, as shown by the general decrease in unit expense as use increased. The acreage increase should be of such a size as to make the fullest use of the implements that have to be duplicated. Where it was not possible to make the fullest use of the added machines the expense was increased and the operator did custom work as a means of controlling this increased unit cost.

The hourly operating expense on the tractor decreased 99 cents with an increase in annual use from 106 hours to 485 hours. A further increase in annual use showed only a slight decrease in expense. The annual expense for 9 binders that harvested an average of 14 acres was $1.03 compared to 31 cents an acre for 7 binders which harvested 76 acres annually.

This study indicated that hired labor increased the annual implement expense. Thus the farmer, to make the most economical use of farm machinery, should when practicable personally operate his implements, particularly the more complex and expensive machines.

The farm repair shop made possible a saving of $5.47 in expense for each $100 of implement investment by the use of 1¼ hours of additional farm labor. Having facilities to repair implements tends to keep implements in better condition and to prevent the loss of time during busy seasons.

Implements that were made of wood and the more complicated machines were housed all the year except during the working season. A study of the effect of housing upon the mower showed a saving of 7.7 cents an acre covered when the machines were housed.

The proper selection and adaptation of implements to the farm needs determine to a considerable extent the service secured. Sixty-two implements were discarded because they were not needed tho still in working condition. Forty implements were discarded because they were not adapted to the work.

TABLE 1. Distribution of Implements by Estimated Life

Kind of implement	Total number of implements	Estimated life—years											Average life per machine
		1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50	Over 50	
Wagon	220	—	10	47	99	29	19	11	1	2	1	1	19.7
Hay frame	180	10	78	67	19	3	3	—	—	—	—	—	11.7
Wagon box	104	2	36	43	10	11	1	1	—	—	—	—	13.5
Buggy	40	1	15	13	9	2	—	—	—	—	—	—	12.8
Sled	23	10	11	1	—	—	1	—	—	—	—	—	7.4
Gasoline engine	20	—	5	6	8	—	1	—	—	—	—	—	15.3
Steam tractor	6	—	—	—	—	—	4	1	1	—	—	—	32.5
Tractor	44½	1	24½	14	5	—	—	—	—	—	—	—	10.6
Tractor plow	27½	—	2½	4	18	1	2	—	—	—	—	—	18.1
Tractor disk	40½	—	3½	14	17	3	3	—	—	—	—	—	17.2
Tractor cultivator	8½	—	2½	3	3	—	—	—	—	—	—	—	13.9
Tractor mower	7½	—	4½	3	—	—	—	—	—	—	—	—	10.8
Sulky plow	33	—	—	1	26	5	1	—	—	—	—	—	20.3
2-horse breaking plow	178	—	4	27	52	56	34	4	—	—	1	—	22.7
3-horse breaking plow	151	—	6	30	43	39	20	6	7	—	1	—	16.3
1-horse breaking plow	189	—	9	10	47	58	44	14	7	—	1	—	24.9
Disk harrow	132	—	3	30	53	27	11	3	3	2	—	—	21.0
Spike harrow	150	—	33	27	61	15	14	—	—	—	—	—	17.2
Smoothing drag	61	17	34	5	2	2	1	—	—	—	—	—	8.6
Roller	29¼	—	—	1	6¼	9½	7½	2	2	1	—	—	27.0
Cultipacker	30	—	—	2	10	10	5	—	1	1	—	1	25.9
Rotary hoe	12½	—	6	4½	2	—	—	—	—	—	—	—	12.8
2-horse riding cultivator	176	—	20	43	85	23	3	2	—	—	—	—	18.0
5-shovel cultivator	32	—	1	11	12	7	—	—	—	—	1	—	19.1
Double shovel	225	—	24	47	58	44	44	—	—	4	2	2	21.7
Rastus	270	—	12	90	103	41	22	2	—	—	—	—	19.2
1-horse harrow	310	—	20	100	93	47	44	5	1	—	—	—	20.0
Single shovel	21	—	1	3	9	1	6	1	—	—	—	—	22.1
1-horse corn planter	13	—	1	5	4	1	2	—	—	—	—	—	18.8
2-horse corn planter	95½	—	4	19	33½	19	16	2	1	1	—	—	21.0
Grain drill	82½	—	2	8	23	19	14½	8	7	1	—	—	24.8
Hand grass seeder	251	94	93	31	26	6	—	—	—	—	—	1	9.4
Team grass seeder	6	—	—	—	1	1	2	—	2	—	—	—	30.5
Plant setter	15	—	—	—	7	6	1	—	—	—	1	—	24.1

TABLE 1. Distribution of Implements by Estimated Life—Continued.

Kind of implement	Total number of Implements	Estimated life—years											Average life per machine
		1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50	Over 50	
Hand plant setter	8	—	5	2	1	—	—	—	—	—	—	—	11.5
Mower	130	2	10	50	37	17	9	3	1	1	—	—	18.0
Bull rake	15	—	5	6	2	2	—	—	—	—	—	—	14.4
Sulky rake	93½	—	—	8	32½	23	24	2	4	—	—	—	24.2
Hay tedder	14	—	—	2	6	1	3	—	2	—	—	—	24.1
Hay press	10½	—	—	2½	3	1½	2½	1	—	—	—	—	23.0
Hay fork	78	—	—	—	5	7	41	16	6	2	1	—	31.3
Lespedeza seed pan	27	16	11	—	—	—	—	—	—	—	—	—	6.0
Grain binder	56	—	2	6	23	13	11	1	—	—	—	—	21.9
Tobacco hiller	9	—	2	1	2	3	—	—	1	—	—	—	21.1
Corn sheller	29	—	—	1	4	4	12	2	2	1	1	1	32.1
Ensilage cutter	9	—	—	2	4	2	1	—	—	—	—	—	22.2
Wagon harness	237	—	3	74	78	40	37	5	—	—	—	—	19.5
Other harness	669	—	114	239	223	39	48	6	—	—	—	—	17.0
Cream separator	36	1	16	9	4	4	1	1	—	—	—	—	14.9
Cold water cream separator	25	5	18	1	1	—	—	—	—	—	—	—	8.9
Self-feeder	29	1	7	12	8	1	—	—	—	—	—	—	13.4
Incubator	12	—	3	3	4	2	—	—	—	—	—	—	16.5
Brooder	10	—	3	6	1	—	—	—	—	—	—	—	13.2
Portable hog house	6	—	4	—	2	—	—	—	—	—	—	—	13.3
Manure spreader	38¼	—	2	17	11	2¼	3	2	1	—	—	—	18.4
Lime spreader	18	—	1	7	5¼	2½	2¼	—	—	—	—	—	18.2
End-gate lime spreader	10	—	3	2¼	4¼	½	—	—	—	—	—	—	15.0
Feed grinder	12½	—	2	2	4	3½	1	—	—	—	—	—	19.0
Fanning mill	11½	—	—	1	5	2	2	—	½	—	1	—	25.5
Tobacco sprayer	9	3	1	1	4	—	—	—	—	—	—	—	11.1
Grindstone	65	1	—	8	13	8	21	2	6	2	3	1	29.7
Emery	21	4	8	3	3	—	1	2	—	—	—	—	13.7
Truck	5	1	1	3	—	—	—	—	—	—	—	—	11.8
1-horse block	5	2	3	—	—	—	—	—	—	—	—	—	6.0
Cutter bar	5	2	3	—	—	—	—	—	—	—	—	—	7.2
Side delivery rake	5½	—	1½	2	2	—	—	—	—	—	—	—	13.6
Orchard sprayer	5	1	—	2	2	—	—	—	—	—	—	—	13.8

TABLE 2. Use and Expense of Miscellaneous Implements

Kind of implement	Number of implements	Average number of 10-hr. days annual use	Total expense per 10-hr. day
Wagon	220	55.8	$0.21
Hay frame	180	46	.06
Wagon box	104	38.7	.07
Buggy	40	37.6	.58
Sled	23	11.8	.07
Hay fork	78	2.7	.65
Corn sheller	29	3.9	.26
Cream separator	36	14.7	.84
Cold water cream separator	25	325.0[1]	——
Wagon harness	237	48.7	.10
Other harness (single)	669	54.9	.03
Emery	21	4.3	.30
Self-feeder	29	147.6[2]	.01
Fanning mill	11.5	3.5	.79
Grindstone	67	1.7	.20
Gasoline engine, 1½ H. P.	10	65.5	.36[3]
Steam tractor	6	36.5	8.30[3]
Hay press	10.5	19.9	.19[4]
Ensilage cutter	8.7	5.9	5.70
Incubator	12	37.1[2]	.12[3]
Brooder	10	46.1[2]	.19[3]
Feed grinder	12.5	13.3	.75
Log wagon	1	20	.41
Saw mill	1	15	2.03
Cut off saw	2	1	2.92
Truck	5	37.9	.03[5]
Gasoline engine, 2½ H. P.	2	99	.50[3]
Gasoline engine, 3 H. P.	5	49.5	1.27[3]
Gasoline engine (small misc'l)	3	19.8	1.36[3]
Electric motor	4	46.5	.36
Clover huller	1	2.5	33.52
Rock crusher	1	25	.24[4]
Thresher	4	18	8.85
Corn shredder	3	9.7	5.07

[1] Twelve-hour day.
[2] Given in days actually used.
[3] Includes cost of fuel.
[4] Cost per ton.
[5] Cost per mile. Does not include cost of license.

TABLE 3. Use and Expense of Crop Production Implements

Kind of implement	Number of implements	Average number of 10-hr. days annual use	Acres covered annually	Acres covered 10-hr. day	Total expense an acre
Tractor implements:					
Plow	27.5[1]	6.0	41.6	6.9	$0.36
Disk harrow	40.5	10.2	204.7	20.0	.07
Cultivator	8.5	8.7	184.1	21.2	.10
Mower	7.5	9.7	189.6	19.5	.13
Breaknig plows:					
Sulky	33.0	12.7	31.2	2.5	.24
2-horse	178.0	7.3	13.7	1.9	.21
3-horse	151.0	11.5	27.7	2.4	.15
1-horse	189.0	1.8	6.5	3.6	.13
Disk harrow	132.0	11.6	83.0	7.2	.07
Spike harrow	150.0	5.3	73.4	13.8	.04
Smoothing drag	61.0	6.6	77.4	11.7	.01
Roller	29.2	3.9	63.6	16.3	.05
Cultipacker	30.0	5.0	78.8	15.6	.07
Rotary hoe	12.5	13.1	177.7	14.2	.06
Cultivators:					
2-horse riding	176.0	13.4	88.3	6.6	.09
5-shovel	32.0	5.3	19.1	3.6	.04
Double shovel	225.0	4.7	15.9	3.4	.05
Rastus	270.0	6.8	21.7	3.2	.06
1-horse harrow	310.0	4.4	17.8	4.0	.05
Single shovel	21.0	1.8	7.4	4.1	.05
1-horse corn planter	13.0	2.8	17.3	6.2	.11
2-horse corn planter	95.5	5.5	64.9	11.8	.10
Grain drill	82.5	3.7	40.9	11.1	.20
Hand grass seeder	251.0	1.4	25.9	18.5	.01
Team grass seeder	6.0	1.7	19.2	11.3	.26
Plant setter	14.0	5.5	22.4	4.1	.42
Hand plant setter	8.0	3.1	2.5	.8	.26
Tobacco hiller	9.0	3.6	15.3	4.2	.06
Mower	130.0	6.7	56.4	8.4	.23
Rakes:					
Bull	15.0	7.2	90.5	12.6	.08
Sulky	93.5	2.9	48.6	16.8	.06
Hay tedder	14.0	1.3	23.2	17.8	.23
Seed pan	27.0	3.4	20.8	6.1	.13
Grain binder	56.0	3.2	39.2	12.3	.49
Manure spreader	38.2	16.6	29.4	1.8	.48
Lime spreader	18.0	5.4	54.3	10.0	.13
End-gate lime spreader	10.0	5.5	55.0	10.0	.12
Tobacco sprayer	9.0	3.5	8.7	2.5	.18
Bull rake	2.0	8.5	87.5	10.3	.15
Disk tiller	1.0	7.9	79.0	10.0	.17
Acme harrow	1.0	1.2	10.0	8.3	.36
Gang plow	1.0	1.5	10.0	6.7	1.37
Spring tooth harrow	1.0	4.3	45.0	10.5	.05
2-row cultivator	1.0	20.4	295.0	14.5	.05
2-H. walking cultivator	1.0	2.2	16.0	7.3	.21
Fallow cultivator	1.0	1.0	5.0	5.0	.32
7-tooth harrow	4.0	3.5	22.7	6.5	.03
Hand corn planter	1.0	2.4	25.0	10.4	.01
Side delivery rake	5.5	5.4	95.4	17.7	.16
Combine	1.0	11.9[2]	93.0	7.8	2.14[3]
Corn binder	2.0	6.3	61.0	9.7	.24
Corn cutter	4.0	3.6	28.7	8.0	.19
Power sprayer	1.0	10.0	50.0	5.0	1.82[4]
Orchard sprayer	5.0	2.5	3.7	1.5	.42
1-horse seed and fertilizer drill	1.0	2.0	20.0	10.0	.14

[1] Indicates some are partnership implements.
[2] 5.6 days was threshing.
[3] Per hour.
[4] Includes gasoline and oil for motor.

TABLE 4. Percentage Distribution of Total Annual Expense of Implements Based on Original Cost

Kind of implement	No. of implements	Original cost per implement	Percent of original cost			
			Total annual expense	Annual depreciation	Annual repair expense	Other annual expense
Truck	5	$547.00	19.0	10.0	4.2	4.8
Electric motor	4	53.75	31.1	20.8	5.6	4.7
Tractor implements:						
Bull rake	2	95.00	13.4	8.3	.5	4.6
Disk tiller	1	150.00	9.0	5.0	___	4.0
Gang breaking plow	1	135.00	10.2	7.1	___	3.1
Cultivators:						
Two-row	1	115.00	13.8	5.6	4.3	3.9
2-horse walking	1	40.00	8.2	4.0	1.3	2.9
7-tooth harrow	4	7.25	9.8	5.7	.4	3.7
Clover huller	1	950.00	8.8	5.0	.5	3.3
Combine	1	1,800.00	14.2	10.0	.8	3.4
Thresher	4	1,802.50	11.8	6.7	3.1	2.0
Corn cutter	4	41.75	13.1	6.1	3.3	3.7
Corn binder	2	150.00	9.9	6.0	.7	3.2
Corn shredder	3	441.77	11.2	6.1	1.6	3.5
Rock crusher	1	480.00	18.9	3.3	12.5	3.1
Orchard sprayer	5	13.70	11.3	7.4	.2	3.7
Power sprayer	1	650.00	13.4	10.0	___	3.4
Cut-off saw	2	26.50	11.0	5.0	2.8	3.2
Saw mill	1	320.00	9.5	3.3	3.1	3.1

TABLE 5. Fuel Consumed, Expense Per Hour[1] and Percent Distribution of Time for 45 Tractors

Kind of work	Number of tractors	Total hours tractor work	Percent of total hours work	Per tractor	
				Gallons fuel per 10-hour day	Total expense per hour
All work	45	12,683	100	___	___
Drawbar:	43	8,260	65.2	18.6	$0.81
Disking	42	4,038	31.9	19.1	.83
Plowing	24	1,719	13.6	20.5	.85
Harrowing	10	454	3.6	17.6	.79
Cultivating corn	8	740	5.8	16.3	.81
Mowing	8	652	5.1	15.3	.72
Cutting grain	5	136	1.1	16.5	.76
Dragging	4	155	1.2	19.3	.82[2]
Raking (bull rake)	2	170	1.4	15.0	.74
Disk tiller plowing	1	79	.6	16.7	.77
Rotary hoe cultivating	1	54	.4	16.7	.77
Combining	1	63	.5	20.8	.86
Belt:	24	4,423	34.8	15.6	.72
Pressing hay	11	1,476	11.6	14.3	.72
Feed grinding	9	1,465	11.5	16.2	.71
Silo filling	8	265	2.1	16.9	.78
Shredding	5	452	3.6	16.9	.77
Threshing	3	465	3.7	16.8	.76
Sawing	3	30	.2	10.0	.71
Shelling corn	1	20	.1	6.0	.60
Crushing rock	1	250	2.0	23.0	.87

[1] Only includes cost of tractor.
[2] Relatively few hours of annual use account for high cost per hour.

TABLE 6. Relation of Crop Acres to Number and Kind of Implements

	Number of implements per farm					
	Less than 50 crop acres	51 to 100 crop acres	101 to 150 crop acres	151 to 200 crop acres	201 to 250 crop acres	Over 250 crop acres
Number of farms	11	35	23	12	11	9
Average crop acres	36	74	128	171	216	414
Kind of implement:						
Wagon	1.18	1.60	2.00	2.42	3.54	4.10
Mower	.91	1.10	1.26	2.00	1.45	1.56
Spike harrow	.91	1.16	1.50	2.00	2.36	1.67
Rastus	1.18	2.09	2.86	3.00	4.08	4.11
Disk harrow	.73	1.06	1.34	1.58	1.73	2.00
2-horse breaking plow	1.45	1.74	1.50	2.42	1.73	2.00
Double shovel	1.27	1.57	2.30	3.42	3.36	2.78
3-horse breaking plow	.36	.82	1.86	1.92	2.54	2.67
Grain drill	.27	.46	.89	1.00	1.10	1.67
2-horse corn planter	.64	.81	1.00	1.08	1.10	1.33
Grain binder	.18	.25	.47	.67	1.00	1.67
Tractor	.09	.17	.61	.60	.59	1.11
Manure spreader	.27	.20	.27	.60	.82	.89
Roller	.09	.21	.37	.50	.45	2.22
Cultipacker	——	.09	.39	.50	.45	.78
Lime spreader	.11	.21	.13	.42	.45	.78
Gasoline engine	——	.09	.17	——	.45	.89
Plant setter	——	.06	.15	.19	.36	.89
Ensilage cutter	.09	.03	.29	.25	.14	.22
2-horse cultivator	.64	1.20	2.13	1.75	3.27	2.33

TABLE 7. Discarded Farm Implements[1]

	No. farms	No. implements	Cost and use per implement						Reason for discarding			
									Not needed		Not adapted	
			Years of service	Original cost	Present value	Acres covered annually	Annual use (days)	Annual repair expense	Useable	Out of repair	Too expensive	Work[2] unsatisfactory
Buggy	2	2	19	$125.00	$20.00	----	140	$8.50	2	---	---	---
Gasoline engine	6	6	9	217.50	47.33	----	39	1.17	4	1	1	---
Tractor plow	12	12[3]	6	132.08	23.75	41	5	.96	6	3	3	---
Tractor disk	1	1	2	125.00	35.00	50	2	----	1	---	---	---
2-horse plow	1	2	10	12.50	1.00	15	4	1.50	---	2	---	---
Sulky plow	2	2	9.5	45.00	17.50	45	17.5	.75	1	---	---	1
3-horse plow	6	9	12.6	16.83	6.00	34	10.6	1.90	4	1	---	4
1-horse plow	5	11	13.2	7.91	2.00	6	1.3	.23	6	---	---	5
Disk harrow	2	2	15	42.50	10.00	31	4.5	.75	1	1	---	---
2-horse cultivator	1	1	11	75.00	20.00	75	9	4.50	---	---	1	---
Alfalfa cultivator	1	¼	4	15.00	2.00	6	2	----	---	---	---	1
5-shovel cultivator	1	2	15	5.00	2.00	15	8	.25	---	---	---	2
Double shovel	4	16	10.7	5.00	1.44	19.6	4.8	.47	5	---	---	11
Rastus	2	3	9.7	7.33	.67	24	3.7	1.00	---	3	---	---
Tobacco hiller	1	1	5	15.00	5.00	20	3	----	---	---	---	1
Grain drill	5	5	11.4	62.00	10.20	34	2.4	.80	5	---	---	---
Team grass seeder	4	6	5.1	68.33	8.33	28.3	2.1	1.00	---	---	---	6
Mowing machine	3	3	8.3	65.00	8.33	43.3	5	4.33	---	2	1	---
Hay tedder	1	1	1	35.00	10.00	25	2	----	1	---	---	---
Hay press	2	2	12	350.00	66.00	----	----	2.50	2	---	---	---
Hay fork	3	4	3	10.67	6.67	----	2	----	3	---	---	---
Grain binder	4	4	11.8	112.50	13.33	48	3.9	.30	3	1	---	---
Cream separator	3	3	9.6	78.33	30.67	----	12.7	.33	3	---	---	---
Cream separator (C. W.)	2	2	3.5	3.75	1.00	----	365	----	2	---	---	---
Incubator	4	5	4	21.00	3.50	----	27	.49	4	---	1	---
Brooder	1	1	8	12.00	5.00	----	20	2.00	1	---	---	---
Feed grinder	1	1	.. ....	18.00	----	----	----	----	1	---	---	---
Fanning mill	2	2	21.5	32.50	4.50	----	1.5	----	1	---	---	1
Seed pan	1	1	----	25.00	20.00	----	----	----	1	---	---	---
Corn cutter	1	1	3	40.00	5.00	5	1	----	---	---	---	1
Corn sheller	1	1	14	25.00	3.00	----	2	----	1	---	---	---
Lime spreader	1	1	10	45.00	10.00	100	4	4.00	1	---	---	---
Emery	1	1	10	8.00	2.50	----	1	----	1	---	---	---
Rock crusher	1	2	5.5	315.00	200.00	100[4]	7	10.00	2	---	---	---

[1] Implements worn out are not included.
[2] May be replaced by another implement.
[3] Two plows were never used. One bought second hand.
[4] Tons of rock crushed.

INDEX

	Page
Alfalfa, red colver and sweet clover, black-stem of	55–82
Amburgey, L. V., and others, Bulletin 340 by	83
Analyses of feeds	88–91
Black-stem of alfalfa and clovers	55–82
the organism described	69
prevalence and importance	57
symptoms of the disease	59
Boyden, R. E., and others, Bulletin 342, by	133–148
Bradley, C. J., Bulletin 343, by	149–188
Bulletin	
337 Cod liver oil for laying pullets	1
338 Hemolytic streptococci of horses and other animals, and their relation to the streptococci of man	23
339 Black stem of alfalfa, red clover and sweet clover	55
340 Commercial feeds in Kentucky in 1932	83
341 Resistance of red clovers to Sclerotinia trifoliorum, Erik., and infection studies	113
342 The iron and copper content of egg yolk	133
343 The use of credit on selected Kentucky farms	149
344 Marketing Kentucky livestock by motor truck	189
345 The use and expense of farm implements	233
Byers, Geo. B., and Inman, B. T., Bulletin 345, by	233–258
Clovers, red, resistance of, to Sclerotinia trifoliorum	113–131
Cod liver oil, effect of on egg production	7
on fertility and hatchability	12
on weight of chicks	19
on weight of eggs	9
Cod liver oils for laying hens	1–22
Commercial feeds in Kentucky in 1932	83–112
Copper and iron content of egg yolk	145
Credit, use of, on selected Kentucky farms	149–188
Dimock, W. W., and Edwards, P. R., Bulletin 338, by	23
Edwards, P. R., and Dimock, W. W., Bulletin 338, by	23
Egg production, effect of cod liver oil on	7
Egg yolk, iron and copper content of	145
Erikson, S. E., and others, Bulletin 342, by	133–148
Farm implements, use and expense of	233–258
Feeds, miscellaneous, analyses of	88–91
Feeds, results of inspection in 1932	91–112
Fergus, E. N., and others, Bulletin 341, by	113
Hemolytic streptococci of horses and other animals	23–53
Henson, Lawrence, and others, Bulletin 341, by	113

Page
Implements, farm, use and expense of....233–258
Inman, B. T., and Byers, Geo. B., Bulletin 345, by....233–258
Insko, W. M., Jr., and Martin, J. Holmes, Bulletin 337 by 1–22
Iron and copper content of egg yolk....133–148
Johnson, E. M., and Valleau, W. D., Bulletin 339, by.... 55
Laying hens, cod liver oil for 1–22
Livestock, marketing by motor truck 189–231
Marketing Kentucky livestock by motor truck 189–231
Martin, J. Holmes, and Insko, W. M., Jr., Bulletin 337, by.... 1–22
Martin, J. Holmes, and others, Bulletin 342, by....133–148
Motor truck, marketing livestock by 189–231
Phillips, C. D., Bulletin 344, by 189–231
Red clovers, resistance of, to Sclerotinia trifoliorum 113–131
Resistance of red clovers to Sclerotinia trifoliorum 113–131
Spears, H. D., and others, Bulletin 340, by 83
Streptococci, hemolytic, of horses and other animals.... 23–53
Terrell, W. G., and others, Bulletin 340, by 83
Turner, J. D., and others, Bulletin 340, by.... 83
Use of credit on selected Kentucky farms....149–188
Use and expense of farm implements....233–258
Valleau, W. D., and Johnson, E. M., Bulletin 339, by.... 55
Valleau, W. D., and others, Bulletin 341, by.... 113